

ABSTRACT

Wireline NMR well logging measurements suffer from disadvantages of poor vertical resolution, logging speeds less than 20 ft/min, and power consumption in excess of 200 W. In spite of these disadvantages, NMR well logging is used because it is capable of providing estimates for a number of petrophysical parameters that are difficult to obtain from other wireline data. These include estimates of the bulk volume irreducible (BVI) of fluids in the formation. The present invention targets BVI and clay bound water (CBW) measurements. Logging speeds of up to 60 ft/min are attainable with little or no loss of resolution. In one preferred embodiment, the tool has four sensors circumferentially distributed around the logging tool and in contact with the borehole wall. A horseshoe like magnet is used to generate the static magnetic field. The magnet poles are designed such that the magnetic field is uniform perpendicular tool motion, as well as provide a sufficiently large extent of the static field to provide polarization for bound water in rock formations. The RF portion of the sensor is comprised of at least one coil configured for transmission of an RF magnetic field into rock formations and at least two coils configured to separately receive the NMR signal from the formation. In another embodiment a coil is wound around the pole pieces or the iron yoke for the purpose of field shifting to enable acquisition of phase-alternated measurements.